

# PATENT ABSTRACTS OF JAPAN

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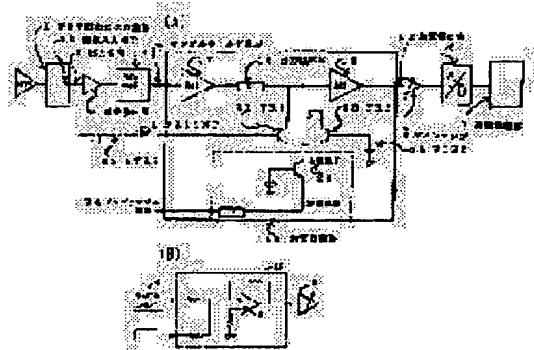
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## (54) TFT DRIVEN LCD SUBSTRATE INSPECTING DEVICE

### (57)Abstract:

**PURPOSE:** To provide an inspecting device capable of precisely deciding an open defective mode in the inspecting device detecting a pixel fault of a TFT drive LCD substrate. **CONSTITUTION:** An adder circuit 16 capable of performing on/off switching of a constant current synchronously with an output signal 2 from the image input terminal 10 of the TFT drive LCD substrate 1 is provided between a sample-and-hold output 8 and a gain amplifier 5, and respective pixels 27 each the pixel to be tested are driven selectively in an image display mode, and each of output level differences of adder outputs 12 from a buffer amplifier BA1.18 between an effective pixel period and a blanking period is eliminated. Thus, the adder outputs 12 corresponding to respective pixels 27 and made to be the signals with only a minute difference are inputted to a gain amplifier 5 to be amplified, and thereafter, each of the outputs 12 is converted to a digital signal by an A/D converter 6 to be image displayed by an image processing part 7, and the presence of the defective pixel is detected.



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10 [Claim(s)]

[Claim 1] Make each pixel (27) of a measured TFT drive LCD substrate (1) drive alternatively in image display mode, and the signal from a driver is inputted into a common-electrical-ground terminal. The output signal (2) from the image input terminal of the above-mentioned measured TFT drive  
15 LCD substrate (1) is sampled in a sample hold circuit (4). In the test equipment which amplifies the output signal of the above-mentioned sample hold circuit (4) with gain amplifier (5), carries out A/D conversion with an A/D converter (6), and detects a pixel defect in the image-processing section (7). Between the above-mentioned sample hold circuit (4) and the  
20 above-mentioned gain amplifier (5) Prepared the adder circuit (16) which adds or subtracts the offset voltage which is equivalent to the signal level difference of VSH (15) at the blanking period (14) of measurement, or the period of an effective pixel period (13), and keeps the reference level of output voltage constant. TFT drive LCD substrate test equipment characterized by  
25 things.

[Claim 2] An adder circuit (16) is TFT drive LCD substrate test equipment according to claim 1 which carries out series connection of the 1st buffer

amplifier (17), and output resistance (19) and the 2nd buffer amplifier (18), and is characterized by being the adder circuit (18) which draws constant current I (20) in the period of control pulse TR1CNT(11) through the 1st current switching component TR1 (21) from between the above-mentioned 5 output resistance (19) and the above-mentioned 2nd buffer amplifier (18).

[Claim 3] An adder circuit (16) is TFT drive LCD substrate test equipment according to claim 1 characterized by being the adder circuit (16) which consisted of an operational amplifier (9) and two or more resistance.

[Detailed Description of the Invention]

10 [0001]

[Industrial Application] This invention relates to the signal amplifying circuit of the test equipment which detects the pixel defect of a TFT (THIN FILM TRANSISTOR) drive LCD (LIQUID CRYSTAL DISPRAY) substrate.

[0002]

15 [Description of the Prior Art] In the test equipment of the pixel defect of the TFT drive LCD substrate by the conventional technique, JP,5-158056,A is utilized as most effective method. That is, it is the method which drives alternatively each pixel of the TFT drive LCD substrate before liquid-crystal (LIQUID CRYSTAL) impregnation in image-display mode, inputs a direct 20 current or a pulse wave signal into the common-electrical-ground terminal to which each [ these ] pixel is connected, detects the amplitude value corresponding to each pixel of the signal outputted to the image input terminal of the above-mentioned substrate, detects the defect in each pixel of a TFT drive LCD substrate by the amplitude value, and performs a quality 25 judging.

[0003] The block diagram of the conventional technique is shown in drawing 3, and the timing chart in drawing 3 is shown in drawing 4. Furthermore,

the equal circuit [ in / for some block diagrams of the configuration of a TFT drive LCD substrate / the configuration of drawing 5 ] of 1 pixel is shown in drawing 5 at drawing 6 . There are poor opening and short [ poor ] in the mode of a pixel defect. Among those, since the signal to output becomes large  
5 unusually, it can distinguish short [ poor ] easily. However, precision was not improved by the judgment of poor opening by the method of the above-mentioned signal amplifying circuit. Although "retention volume" is formed in each pixel part in order to make a part for predetermined time, i.e.,  
10 1 frame time, until the next screen is displayed, and a picture signal save when image display is carried out in each pixel part, the reason It is because about 1/100 and capacity are small if the value of this retention volume C28 is compared with the sum total of the parasitic capacitance CD 30 produced on the drain line 25 for constituting the parasitic capacitance valve flow coefficient 29 and each pixel of the video input line 26 as shown in drawing 5  
15 and drawing 6 .

[0004] For this reason, when it was going to detect poor opening among the defect modes of the retention volume C28 in each pixel, even if retention volume C28 was normal or unusual, only the minute difference was produced between the amplitude value of that output signal, but it had the trouble that  
20 it was difficult to carry out to it judging that quality exactly. Namely, since the difference of the reference level of the signal of the effective pixel period 13 and the blanking period 14 which are shown in drawing 4 D and F is large when it is inspection of a TFT drive LCD substrate although what is necessary is just to raise the gain of amplifier if it is a simple minute signal,  
25 It is because gain of the gain amplifier 5 can seldom be enlarged for a limit of the supply voltage of a component circuit, and a limit of the input range of A/D converter 6 if the signal of drawing 4 F which carried out sample hold is

inputted into the gain amplifier 5 of drawing 3 as it is and is amplified. Moreover, since the number of pixels 27 (refer to drawing 5) increased increasingly recently, and  $640 \times 480 = 307,200$  pixels /, and substrate \*\* became a general configuration, therefore parasitic capacitance valve flow coefficient<sup>29</sup> and CD<sup>30</sup> also increased with the increase of the number of pixels, it is the actual condition which the difficulty of detecting the defect of each pixel 27 and performing a quality judging was increasing increasingly.

[0005]

[Problem(s) to be Solved by the Invention] the technical problem which this invention tends to solve is boiling the detection precision in poor opening mode markedly, and raising it in inspection of a pixel defect. In the signal amplifying circuit of the test equipment which detects the pixel defect of the TFT drive LCD substrate before liquid crystal impregnation, namely, for the configuration of a TFT substrate and structure where parasitism electrostatic capacity becomes large The magnitude of the signal which is made to correspond to each pixel, inputs and is detected produces only a minute level difference between an excellent article and a defective. Improvement in defect detection precision the difficult thing It is carrying out A/D conversion, after abolishing the reference level difference of the signal of the effective pixel period 13 and the blanking period 14, raising a S/N ratio and enlarging the signal amplification factor of the gain amplifier 5, and realizing the signal amplifying circuit which shall carry out image display and which a quality judging shall tend to carry out.

[0006]

[Means for Solving the Problem] The adder circuit where constant current is made by ON and off-switching between a sample hold output and gain amplifier synchronizing with the output signal from the image input terminal

of a TFT drive LCD substrate in the amplifying circuit of the test equipment which detects the pixel defect of a TFT drive LCD substrate at the process before liquid crystal impregnation of this invention was prepared. And the output of the buffer amplifier in an adder circuit is corresponded to each pixel  
5 by abolishing the output-level difference of an effective pixel period and a blanking period, and the minute adder output which put, suited and became a signal is inputted into gain amplifier, and is amplified. Then, it changed into the digital signal with the A/D converter, and realized in the signal amplifying circuit which makes it possible to carry out image display in the  
10 image-processing section, and to detect the existence of a pixel defect. Since rapidity was required of the above-mentioned adder circuit, it was made into the method which subtracts and adds offset voltage to the reference level of the signal of a blanking period or an effective pixel period using a high-speed current switching circuit, and makes signal level regularity. As other methods,  
15 although rapidity and precision are a little inferior, it can constitute from an analog adder which subtracts and adds an analog signal using a high-speed operational amplifier. Since the difference of the reference level of the signal of both periods becomes very small compared with the former also by this method, it is effective practically.

20 [0007]  
[Function] detecting the difference in the magnitude of the amplitude of pulse shape which impressed pulse shape from the common earth terminal, and passed each pixel by TFT according to said leading and effective means of the conventional technique -- an excellent article -- or the defect mode poor  
25 opening and short [ poor ] is judged. however, a TFT drive LCD substrate -- constitutionally -- a video input line and a drain line -- the substrate whole -- or it has spread in the part and has parasitic capacitance between each Rhine

(refer to drawing 5 ). As compared with this parasitic capacitance, retention volume C is very as small as about 1/100 (refer to drawing 6 ). Therefore, the part of the retention volume C which most amplitude detected as an output is based on parasitic capacitance, and is superimposed on it on it cannot but be  
5 very small, and the difference of the amplitude which should judge whether opening is poor cannot but be minute. The configuration of this invention was amplifying, after being able to mitigate the part of the amplitude by parasitic capacitance, extracting only the part of a signal required for a judgment and raising a S/N ratio, and in order to make the difference easy to expand the  
10 signal level part of a minute difference and to judge, it made it possible to raise and carry out A/D conversion of the gain of amplifier.

[0008]

[Example] The block diagram of one example of this invention is shown in drawing 1 . Drawing 1 (A) is a constant current switching method, and  
15 drawing 1 (B) is an analog signal addition method by the operational amplifier. The timing chart by the example of drawing 1 is shown in drawing 2 . Drawing 3 is the block diagram of the conventional technique, in order to compare with this invention. It explains using drawing 1 and drawing 2 .

[0009] With the configuration of drawing 1 (A) which is one example of this  
20 invention, synchronizing with the output signal 2 from the image input terminal 10 of the TFT drive LCD substrate 1, ON of constant current and OFF could be switched between the sample hold output 8 and the gain amplifier 5, and the adder circuit 16 which subtracts and adds offset voltage was established in it. With the output of the charge detector 3, the level  
25 difference of the effective pixel period 13 and the blanking period 14 is far larger than the level difference of an excellent article pixel and a defective pixel. In order to make this level difference small, the 1st switching element

TR 1-21 is made to turn on by control pulse TR1CNT11 to which only the blanking period 14 made reference level VTR 2-23 which is the control electrical potential difference of the 2nd switching element TR 2-22 in an adder circuit 16, and the potential difference of  $I_xR$  is generated for a current 5 I-20 between the terminals of the output resistance R19 of a sink and the 1st buffer amplifier BA 1-17. Thereby, only in the blanking period 14, a voltage level falls [ the value of  $I_xR$  ] with the output of the 2nd buffer amplifier BA 2-18. Sample hold output-level difference  $VSH15=I_xR$  of the effective pixel period 13 and the blanking period 14 With 2-2nd buffer amplifier BA18 10 output, the output-level difference of the effective pixel period 13 and the blanking period 14 becomes small by setting up the current value I-20 which becomes by the programmable power supply 24. Here, a programmable power supply 24 uses what is prepared in the body of LCD substrate test equipment. 15 [0010] Therefore, as shown in drawing 2 H, the above-mentioned output-level difference is lost, and the adder output 12 which corresponded to each pixel 27 and became the signal of only the part of a minute difference is inputted into the gain amplifier 5, and is amplified greatly. It made it possible to change into a digital signal with A/D converter 6, to carry out image display in the image-processing section 7, to detect the existence of the pixel defect in 20 each pixel 27, and to judge a quality after that.

[0011] Although only the blanking period 14 made it flow through the 1st switching element TR 1-21 and dropped the signal level of the blanking period 14 in this one example, it is made to usually flow through the 1st switching element TR 1-21 conversely, and only the effective pixel period 13 25 may make it flow through the 2nd switching element TR 2-21, the 1st switching element TR 1-21 may be made to intercept, and the signal level of the effective pixel period 13 may be raised.

- [0012] Other examples of an adder circuit 16 are shown in drawing 1 (B). Although it is an analog adder circuit using an operational amplifier 9 and resistance and rapidity and precision are a little inferior, it can be equal to practical use.
- 5 [0013] Even if said examined pixel is the pixel 27 of the TFT drive LCD substrate 1 after liquid crystal impregnation, it can inspect by the signal amplifying circuit for detecting the pixel defect by the configuration of this invention.
- [0014] Moreover, although it explains as TFT (thin film transistor), even if  
10 the active switch of a matrix part is not TFT, as long as the transistor which forms the active switch matrix of the examined component made into an object according to the configuration of this invention is shown by the equal circuit 31 of drawing 6, it may be FET (FIELD-EFFECTTRANSISTOR) or other methods.
- 15 [0015]  
[Effect of the Invention] Since this invention is constituted as explained above, it does so effectiveness which is indicated below.  
(1) Insert the adder circuit which can carry out ON of constant current I, and off-switching synchronizing with the output from TFT between a sample hold  
20 output and gain amplifier. The part in which the difference of a minute signal exists can be amplified and expanded because it became possible to amplify only the part of a required signal. The inspection precision in the poor opening mode made the most difficult [ detection ] in inspection of the pixel defect of a TFT drive LCD substrate improved, and the quality judging in  
25 inspection of pixel quality became very easy.  
(2) Since only the part of the signal which a judgment needs can be amplified even when the number of pixels increases with enlargement of a TFT drive

LCD substrate, parasitic capacitance also increases and the S/N ratio of a signal falls further by having considered as the configuration of this invention, the detection precision for a quality judging is maintainable.

(3) If it is a signal amplifying circuit by signal-control processing of the 5 configuration of this invention, it is very more effective still in performing a quality judging by carrying out magnification expansion of the signal only not only with inspection of a TFT drive LCD substrate but other minute level differences.

[Brief Description of the Drawings]

10 [Drawing 1] Drawing 1 (A) is the block diagram showing one example of this invention, and drawing 1 (B) is drawing showing other examples.

[Drawing 2] The timing chart by the example of drawing 1 is shown.

[Drawing 3] The block diagram of the signal-control circuit which detects the pixel defect of the TFT drive LCD substrate of the conventional technique is 15 shown.

[Drawing 4] The timing chart in the case of drawing 3 is shown.

[Drawing 5] It is the block diagram showing one part of the configuration of a TFT drive LCD substrate.

[Drawing 6] The equal circuit at the time of observing 1 pixel in the 20 configuration of drawing 5 is shown.

[Description of Notations]

1 TFT Drive LCD Substrate

2 Output Signal

3 Charge Detector

25 4 Sample Hold

5 Gain Amplifier

6 A/D Converter

- 7 Image Processing Section**
- 9 Operational Amplifier**
- 8 Sample Hold Output**
- 10 Image Input Terminal**
- 5   **11 TR1CNT**
- 12 Adder Output**
- 13 Effective Pixel Period**
- 14 Blanking Period**
- 15 VSH**
- 10   **16 Adder Circuit**
- 17 1st Buffer Amplifier BA 1**
- 18 2nd Buffer Amplifier BA 2**
- 19 Output Resistance R**
- 20 Current I**
- 15   **21 1st Switching Element TR1**
- 22 2nd Switching Element TR2**
- 23 VTR2**
- 24 Programmable Power Supply**
- 25 Drain Line**
- 20   **26 Video Input Line**
- 27 Pixel**
- 28 Retention Volume C**
- 29 Parasitic Capacitance Valve Flow Coefficient**
- 30 Parasitic Capacitance CD**
- 25   **31 Equal Circuit**
- R1 ON resistance of Pixel TFT**
- R2 ON resistance of the drain line selection TFT**